FALLS IN THE ELDERLY

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Falls are common problems for older people. Approximately 30 to 50% of community residing people report having fallen or a liability to fall during the past 12 months.[1-5] Among the institutionalized elderly, up to 20% of hospital patients[6] and 45% of long-term-care facility residents will fall.[7] Unfortunately, these figures understate the problem, since the vast majority of falls by older people are underreported.[8] Typically, the only falls reported are those that lead to physical injury or a significant decline in functional status. In the community, older people may not report a fall because they falsely attribute the event to a "normal" consequence of aging, or fear that reporting a fall will lead to restriction of activities or placement in a nursing home. As well, the personal embarrassment one suffers from falling or a denial of the incident, especially if it reminds one of increasing frailty and dependency, may be further reasons for underreporting by the aged. Within the institutional setting, patients may fail to report their fall if they have an element of cognitive dysfunction, fear of physical restraints, or concern over being denied discharge back to the community.

In terms of mortality, falls represent the leading cause of death due to unintentional injury.[1] Fall-related mortality increases with advanced age and more than doubles with each decade of life.[9] While falls are associated with excess mortality, most falls do not end in death.[10] However, the morbidity associated with falling is considerable. A fracture is the most common injury, and the hip is the most common fracture to result in acute hospitalization.[11] Of the 200,000 hip fractures that occur annually, 84% occur to persons 65 years of age and older.[12] The length of hospital stay for hip fracture patients is nearly twice the stay for all other causes of hospital admission by the elderly,[12] and approximately 40% of older people with hip fractures die within six months of the injury.[13] Of these persons who survive the hip fracture 60%

have significant mobility problems as a result,[13] and another 25% become more functionally dependent.[14]

Falls that do not result in physical injury can lead to self-imposed immobility resulting from a fear of falling again.[10,15] Prolonged immobility can lead to joint contractures, pressure sores, urinary tract infections, muscle atrophy, psychological depression, and functional dependency.[10] As a result, falls are a common reason for institutionalization. Approximately 25% of hospital admissions of the aged are directly attributable to falling,[16] and 47% of patients admitted to the hospital for falls become long-term-care stay patients.[16] Those elderly with recurrent falls, declining mobility, and a fear of falling again are often readmitted to a hospital[17] or placed in a nursing home for permanent care.[18]

THE ETIOLOGY OF FALLING

Falling, by itself, should not be viewed as a disease, but as a sign or symptom of an underlying problem. For example, abdominal pain usually indicates underlying peptic ulcer disease, appendicitis, gall bladder disease, diverticulitis, or intestinal obstruction. In similar fashion, a fall is symptomatic of several intrinsic (i.e., "normal" physiological aging changes, pathological and psychological disease states, and medications) and extrinsic (i.e., environmental hazards) factors. The fall may not be the direct consequence of any single intrinsic or extrinsic factor in isolation, but often represents several events operating simultaneously. Therefore, just as one would not dismiss a patient with abdominal pain without investigation into its etiology, a fall patient should not be overlooked without first ruling out a multitude of reversible factors.

NORMAL AGING CHANGES

With advancing age, the visual, neurological, cardiovascular, and musculoskeletal systems are influenced by several "normal" age-related physiologic changes that place older people at risk of falling.

Vision. With increasing age, pupillary response diminishes, decreasing accommodation to varying levels of light and darkness.[19] The result is that older people require more time to adjust to environmental lighting changes to walk safely. A greater sensitivity of the aging eye to glare, visual distraction caused by sluggish pupillary reactions, can lead to visual distraction from unshielded light sources and bright lights radiating off highly polished floors.[20] A decrease in lens transparency results in cataract formation, which interferes with the passage of light rays to the retina, diminishes vision, and

increases sensitivity to bright lights. Cataracts may also result in a decreased ability to discriminate between colors of similar intensities, such as blue and green colors.[21] This becomes a problem if older people have difficulty in distinguishing the colors of their medications, and risk a fall secondary to inappropriate medication administration. An age-related decline in depth perception can make the visual detection of similarly colored environmental objects, such as grab bars or hand rails of the same color consistency as surrounding walls, undetectable as safety devices. Visual function can be further impaired by a decrease in peripheral vision, a diminished upward gaze, and central field visual deficits caused by macular degeneration.[22]

Balance/gait. The balancing mechanisms of an older person are affected by changes occurring in the visual, vestibular, and proprioceptive sensory systems. Body sway, the natural motion of the body when standing, normally increases after the sixth decade of life, and decreases bodily stability.[23] Older people with a history of falling have greater sway than those who do not fall.[24] Proprioceptive feedback and vibration sense both decline with age,[31,32] which may interfere with proper foot placement while walking. The righting reflex, a vestibular function which signals the body to initiate positional reflexes in an effort to preserve balance, is diminished in older persons.[27] Changes in gait occur with normal aging and may contribute to falls. Women develop a narrow walking and standing base, and walk with a pelvic waddle.[28] Older men tend to adopt a wide-standing and walking base, a decrease in stride length and steppage height, which results in a small stepped gait.[29] Both sexes decrease walking speed, and spend more time in the support phase of gait.[30]

Cardiovascular. Postural hypotension has been found in relatively healthy people[31,32] due to a decline in the efficiency of baroreceptor reflexes. Postural hypotension may add to balance dysfunction in older people and contribute to falling.

Reaction time. Reaction time and the speed at which a task is performed generally decrease with age.[33] As a result, the length of time between perceiving a hazard and taking action to avoid it increases, as does risk of falling.

Musculoskeletal. Older people, with age, tend to assume a stooped kyphotic posture, with head and neck slightly bent forward and hips and knees flexed. This change, attributable to muscle shrinkage, calcification of tendons and ligaments, and a thinning of the vertebral discs, not only alters the body's balance threshold, but may result in more instability when attempting to stop a fall in progress.

With age, muscular strength and endurance decrease. The proximal mus-

cles of the lower extremities display the greatest decline.[34] Hence older people have difficulty when sitting down or rising from chairs, toilets, and wheel chairs. Arthritis, which occurs normally with age due to continuous deterioration and abrasion of articular cartilage, may contribute to transfer difficulties, especially if the knee joint is affected. Osteoarthritis of the knees prevents the knee joint from assuming an angle of acute flexion between the lower and upper leg, and impairs the ability of the legs to slide underneath a chair to provide leverage when rising. An inability to flex the knees sufficiently may influence the ability to get up from the floor following a fall.

MEDICAL CAUSES FOR FALLING

Most falls in older people occur to those with multiple medical problems. The falling episode may indicate unstable existing disease or the onset of a new undiagnosed medical condition. In either case, a variety of medical factors are to be considered as causes of falling. Virtually every organ system involved in maintaining homeostatic function can be implicated.

Vision. Superimposed on age-related visual changes, dysfunctions in sight constitute a major risk.[35,1] Visual impairment may be transient, presenting as a symptom of hypotension, cardiac arrhythmia, temporal arteritis, or vertebro-basilar artery insufficiency. Progressive visual decline is usually due to cataracts, macular degeneration, glaucoma, or nutritional deficiencies, such as vitamin B_{12} and thiamine deficiency.

Dizziness. Older people frequently complain of dizziness,[36] which results from dysfunction of at least one of a number of balance control systems. Disturbances of the visual pathway, the vestibular apparatus, the proprioceptive tracts of the central nervous system, or altered homeostasis of systemic circulation can result in vertigo, syncope, or lightheadedness. Vertigo is usually defined as a sense of rotation of either the patient or his environment and usually indicates vestibular dysfunction. Almost always associated with nystagmus, poor balance, and autonomic symptoms, vertigo can be caused by peripheral disease (affecting the inner ear or eighth cranial nerve) or central nervous system disease (affecting the brain stem or cerebellum).[37]

Benign positional vertigo. This disorder of the peripheral vestibular system is probably the most common form of vertigo experienced by the elderly. Typically, patients describe a dizzy sensation when they assume a certain position, which subsides when another position is assumed. There is usually a latency period of several seconds between the position change and the onset of dizziness. Accompanying symptoms include rotary or horizontal nystagmus and occasionally tinnitus and nausea. Hearing impairments are

not usually associated with benign postural vertigo. Recent ear infection or head trauma are common precipitating factors.

Meniere's disease may present as dizziness in the elderly, but usually does not appear after the age of 70. Anatomically, the disease is impairment of the auditory and labyrinthine portions of the eighth cranial nerve. The etiology is unknown, although a relationship to endolymphatic hydrops has been suggested. Meniere's disease presents abruptly with severe dizziness accompanied by nausea and vomiting. Each episode lasts from a few minutes to several hours, and attacks occur in clusters with long remission periods of weeks or several months between clusters. Attacks may be triggered by emotional upset, fatigue, or excessive sodium intake.

Acoustic neuroma. All patients presenting with dizziness or a disturbance of balance accompanied by a progressive unilateral hearing loss or tinnitus must be suspected of having an acoustic neuroma, a benign, enlarging tumor arising from the eighth cranial nerve located within the auditory canal. Unilateral sensorineural hearing loss is evident and poor speech discrimination is disproportionate to the degree of hearing loss. As the acoustic neuroma enlarges and infiltrates the cerebellopontine angle, neurological dysfunction becomes more apparent; early signs include a depressed corneal reflex and decreased sensory and motor involvement of the seventh cranial nerve. Patients should have radiographic examinations of the temporal bones and internal auditory canals, including tomography or CT scan, to confirm the presence of a tumor. Surgical excision of the tumor is usually curative.

Labyrinthitis. Patients presenting with dizziness associated with positional change and local ear pain should be suspected of having labyrinthitis. This disorder has three clinical variants: serous, suppurative, and toxic labyrinthitis.

Serous labyrinthitis results from secondary infection of the ear, such as otitis media. Accumulated cerumen in the affected ear can also contribute to an infection. A transient sensorineural hearing loss is present, and caloric response is decreased. Treatment of the underlying infection or removal of cerumen resolves the problem. Suppurative labyrinthitis is an infection characterized by inflammation of the inner ear. Chronic otitis media, cholesteatoma, or fractures of the inner ear are common causes. Toxic labyrinthitis is caused by such ototoxic drugs as the aminoglycosides, aspirin, heavy tobacco use, and loop diuretics. The earliest symptoms of drug ototoxicity are tinnitus and hearing loss. After a while, balance problems may develop, indicating inner ear involvement. Patients may develop dizziness and gait ataxia when the vestibular system is active (during walking), and symptoms

decrease when the vestibular system is inactive (when the patient is lying down). Because toxic labyrinthitis is often irreversible, patients should not be treated with ototoxic drugs unless no alternative medications are available. Audiometry and balance tests, administered both before and during treatment with ototoxic drugs, should be standard procedure.

Transient ischemic attack. Vascular disease that affects the perfusion of the brain by the vertebral and basilar arteries can cause intermittent dizziness. The drop attack is a particular form of vertebro-basilar insufficiency affecting the elderly.[38] It is estimated that up to 25% of falls are due to drop attacks.[38] The patient drops to the ground without a loss of consciousness, states that his legs suddenly gave way, and cannot get up without assistance. The precise mechanism of these attacks is not known, but appears to be associated with cervical abnormalities.[39] Patients should wear cervical collars to prevent backward flexion of the head.

SYNCOPE

Syncope, sudden brief loss of consciousness due to cerebral ischemia, has many underlying causes.[40]

Vasodepressor syncope. The vaso-vagal faint is probably the most frequent type of syncope.[41] Characteristically, a few seconds before an attack, the patient has premonitory symptoms, such as nausea, weakness, sweating, and a sensation of impending loss of consciousness. Typically, attacks occur after emotional upset or injury during prolonged standing in warm environments or after prolonged fatigue.

Orthostatic syncope. In orthostatic hypotension, autonomic factors responsible for compensation for the upright posture fail. In this sense, orthostatic syncope is similar to vasodepressor syncope. However, it is the effect of posture that is the cardinal feature of orthostatic hypotension. Orthostatic hypotension is demonstrated when there is a drop in systolic pressure of 20 mm/Hg or diastolic pressure of 10 mm/Hg between the supine and standing positions without a concomitant rise in pulse rate. While a small percentage of normal, healthy elderly patients may have orthostatic hypotention of unknown etiology,[42,43] common causes include factors that deplete body fluids or cause decreased venous return, medications, and diseases with neurological complications. Antihypertensive drugs, especially those that block or inhibit sympathetic activity, and diuretics, which can cause dehydration, are drugs commonly associated with orthostatic syncope. Neurological diseases causing orthostatic syncope include disorders of the peripheral nerves, such

as diabetic neuropathy,[44] alcoholic neuropathy, and amyloidosis. Postprandial reductions in blood pressure may occur as well. The hypotensive response to eating may be due to splanchnic blood pooling or other local intestinal factors in the presence of inadequate baroreflex compensation. Eating may also affect blood pressure homeostasis through insulin-induced blunting of baroreceptor sensitivity.[45] Patients should be cautioned against sudden rising or activities following meals.

Carotid sinus syncope occurs frequently in older people, many of whom may have underlying sinus node disease. The responsible mechanism is either carotid sinus hypersensitivity[46] or a mechanical obstruction, which interferes with the blood supply to the brain.[47] The stimulus for carotid sinus syncope may be the turning of the head to one side, shaving, or wearing tight collars. Drugs that enhance vagal tone, such as digitalis or propranolol, may also produce carotid hypersensitivity.

Tussive syncope. This form of syncope is usually encountered in patients with chronic obstructive pulmonary disease or bronchitis.[48] Vigorous coughing, followed by loss of consciousness, is the usual history. A severe Valsalva's maneuver is created by high intrathoracic pressures during coughing episodes, decreasing cardiac output. Treatment is directed toward antitussive medications and care of underlying disease process.

Micturition syncope. This syncope is seen primarily in elderly men, presumably because of the upright position for micturition.[48] Patients with bladder outlet obstruction (e.g., from prostatic hypertrophy) and nocturia are at risk. During or immediately following voiding, sudden loss of consciousness occurs, related to vagal bradycardia. Having patients sit during micturition is usually helpful.

Arrhythmias. Cardiac arrhythmias are common causes of syncope.[49] Arrhythmias can occur with either extremely fast or extremely slow heart rates. Supraventricular tachycardias are the most common arrhythmias to cause syncope. The sick sinus syndrome is also frequently associated with dizziness in older patients, for the sinus typically slows with aging. The 12-lead electrocardiogram is essential in the diagnostic evaluation of cardiac syncope. It may reveal significant first-degree heart block or ventricular irritability as the cause of dizziness. If a cardiac arrhythmia is suspected, then prolonged electrocardiographic monitoring is indicated, since it is common for elderly people without symptoms to exhibit arrhythmias as well.[50] Holter monitoring over 24 or 48 hours that reveals transient bradyarrhythmias or tachyarrhythmias during a dizzy spell is diagnostic. If the Holter (prolonged

electrocardiographic recording) is negative over a twenty-four or forty-eight hour period for arrhythmias while the patient has symptoms, arrhythmias can be excluded as a cause of dizziness.

Since rigid definitions of vertigo and syncope do not describe all patients' symptoms, lightheadedness is used to describe symptoms of dizziness without nystagmus or loss of consciousness.

Hypoglycemia can be diabetic or nondiabetic in origin. Although diabetes is always associated with hyperglycemia, the first indication of early diabetes may be a reactive hypoglycemic episode. In these patients, dizziness usually occurs three to five hours after a meal. Although nondiabetic hypoglycemia is rare, it can arise as a result of organic disease, such as pancreatic tumors or adrenocortical hypofunction.

Hypothyroidism. Although vertigo is not considered a usual symptom of hypothyroidism, balance disturbances occur commonly in the hypothyroid state. Cerebellar ataxia, with clinical unsteadiness and truncal ataxia, may be noted. Patients may also complain of sensorineural hearing loss and tinnitus.

Hyperventilation. Patients who are anxious or under emotional stress may have hyperventilation-induced dizziness.[51] A careful history of underlying psychological problems will usually make the diagnosis. Perioral or extremity tingling are suggestive symptoms. Patients with hyperventilation-induced dizziness can reproduce their symptoms by hyperventilating for two or three minutes. Before settling on this diagnosis, however, other causes of dizziness should be excluded.

Visual malfunction. Altered visual perception may cause dizziness when the patient is walking. Visual cues relied upon when descending stairs or making turns are often altered during the transition to new glasses or after cataract surgery. In both instances, time, reassurance, and an ophthalmologic checkup should resolve the problem.

Disequilibrium. Dizziness induced by disequilibrium occurs in such common disorders as Parkinson's disease, Alzheimer's disease, and peripheral neuropathy caused by pernicious anemia, alcoholism, or diabetes. Patients complain of unsteadiness, disturbed balance, a tendency to fall, or a lessened awareness of limb position when walking. Dizziness results from an over-reliance on visual and labyrinthine-vestibular responses to achieve a sense of stability. Unless a specific treatable cause is found for the disequilibrium, the patient can be helped to balance with assistive devices for walking or by discontinuing or replacing any medications that exacerbate imbalance.

GAIT ABNORMALITIES

A number of studies have attributed falls to gait abnormalities.[52,53]

Senile gait. The gradual age-related appearance of a broad-based gait associated with stooped posture, flexion of hips and knees, diminished arm swing, small steps, poor gait initiation, and stiffness in turning has been described as senile gait.[54] While senile gait is unrelated to clinically detectable neurologic or systemic disease, some have attributed this disorder to early Parkinsonism, with only anecdotal results of improvement with L-dopa.[55] The diagnosis of senile gait disorder as a cause of falling should only be made after other potentially reversible gait disorders are ruled out.

Parkinsonism. Falls are a frequent presentation of Parkinsonism.[56,57] Parkinsonism patients undergo a number of gait abnormalities and postural changes that contribute to falling. As the disease progresses, patients may encounter difficulty when rising from a bed or chair due to a failure by the patient adequately to flex his legs closer to his center of gravity.[57] In an effort to rise, patients initiate small rocking motions, and may fall if they do not use their hands to hold themselves in a sitting position. When standing, the ability to maintain an upright posture is impaired by a loss of autonomic postural reflexes. To preserve balance, the patient assumes a stooped posture, with neck, trunk, and limbs held in forward flexion with bent arms and knees. The gait becomes short-stepped and shuffling, and patients complain that their feet feel like they are sticking to the ground. At times, gait initiation becomes difficult, and patients stutter (short rapid shuffling steps) when they walk. A displaced center of gravity leads to propulsion and uncontrolled forward motion that can sometimes only be stopped by walking into an immovable object, or retropulsion, falling backward. To offset the risk of falling forward, patients with propulsion may develop a festination or accelerated forward gait to help maintain a center of gravity. Other gait characteristics that may predispose to falls include a "freezing walk, with the feet suddenly coming to a halt, but the body keeps on moving forward, resulting in a loss of balance. When patients attempt to turn, a loss of ankle movements and associated arm, shoulder, and hip rotation results in turning the body in a fixed unit, which compromises stability.[58]

Hemiplegia. Patients with stroke and mild hemiplegia display poor arm and leg swing, which becomes more obvious during periods of rapid walking. With severe hemiplegia, the knee of the affected limb is held in extension and the ankle is plantar flexed and slightly inverted, as the leg moves in a wide swinging pattern to help with ground clearance. Even so, the hemiplegic foot tends to drag and places the patient at risk for tripping falls. A loss of proprioceptive feedback in the involved limb may lead to uncertain foot placement when walking.

Cervical spondylosis is a very common degenerative finding in the aged.[59]

In most people, cervical spondylosis is a benign condition, but when cervical osteophytes occur posteriorly and impinge on a spinal canal that is narrow, myelopathy may result.[60] The associated myelopathy may lead to non-specific gait complaints, such as ''difficulty climbing stairs,'' ''legs giving away,'' or ''clumsiness of the feet,'' which can cause falls.

Normal pressure hydrocephalus. The syndrome of normal pressure hydrocephalus includes the triad of dementia, urinary incontinence, and abnormal gait.[61] The gait disturbance, an early manifestation of normal pressure hydrocephalus, is characterized by short steps, a slow unsteady walking speed, and ataxia.[62] Falls related to this occur suddenly only while standing and walking, with no warning, and are occasionally accompanied by brief loss of consciousness.[63]

Ataxia. Patients with ataxia walk with a wide-based gait and frequent side-stepping. Common disorders responsible for ataxia include cerebellar disease, hyponatremia,[64] and vestibular dysfunction.

MUSCULOSKELETAL CAUSES OF FALLING

Osteoarthritis. Osteoarthritis can limit the ability to walk, climb stairs, and transfer effectively. Arthritis of the knee may interfere with stability and rising from chairs. The locked position of the knee is an important antigravity mechanism for maintaining balance. When the knee is flexed due to arthritis, the body relies to a great extent on the quadriceps for support. In addition, significant osteoarthritis of the knees may lead to valgus or varus deformity, secondary to involvement of the medial tibiofemoral compartment. This may result in ligamentous weakness and instability, causing the legs to give way or to collapse.

Muscle weakness. Proximal muscle weakness is a leading feature of poly-myalga rheumatica, hyperthyroidism, hypothyroidism, hypokalemia, hyper-parathyroidism, osteomalacia, hyposphatemia, and such drugs as steroids, phenytoin, triampterine, and spironolactone.[65]

Osteomalacia, a condition characterized by deficient mineralization of bone, is a common but unrecognized disorder in the elderly.[66,67] Clinically, patients present with ill-defined skeletal pain. Hip involvement results in pain, which is worse during weight bearing, and proximal muscle weakness, producing an unstable, waddling gait.[68]

Paget's disease is often a clinically benign condition, but if symptomatic, several complications may follow that place patients at risk of falling. Deformities of the lower extremities, as evidenced by tibial bowing and acetabular protusion, can alter gait (due to unequal length and change in distribution of

mechanical forces in the lower extremities) and predispose a patient to fractures that occur spontaneously or with minimal trauma.

PSYCHOLOGICAL CAUSES OF FALLING

Cognitive dysfunction appears to be a risk factor for falling.[3,11,69] Patients with dementia and depression have an excess number of falls.[70] People with senile dementia of the Alzheimer's type display certain alterations in gait and vitamin levels that may explain their high fall frequency. Alzheimer's senile dementia results in patients walking more slowly, with shorter steps, increased double support time, and greater step-to-step variability.[71] Serum vitamin B_{12} levels have been found to be low in such patients, which may lead to proprioceptive loss and increased confusion.[72] Older people with depression are more likely to suffer a loss of concentration, which can lead to judgmental errors, a misperception of environmental hazards, and falls.[73] A loss of friends and family, from either death or relocation, a change in living environments (i.e., entry into a nursing home and giving up one's home), loss of bodily functions (i.e., mobility, cognition, urinary continence), and a decline in performing everyday activities are common reasons for depression. If depression is severe enough, recurrent falling episodes may be a sign of suicidal intent, as people place themselves in hazardous situations beyond their ability to control.[74]

PHARMACOLOGIC CAUSES OF FALLING

Although some studies have failed to demonstrate a relationship between falls and drugs,[75,76] it is generally agreed that medications increase the risk of falling in older people.[77,78,79] Patients who fall either take within a few hours of a fall, or utilize large doses of laxatives,[80] tranquilizers and hypnotics,[81,82] diuretics, psychotropics, or cardiovascular drugs.[83]

ENVIRONMENTAL FACTORS

The environment in which an older person resides plays an important role in either causing or preventing falls. Within the home environment, most falls occur on stairways,[84,85] in the bedroom,[53] and living room.[53] Most falls occur during routine activities such as transferring from beds and chairs,[16,5] walking and tripping over carpets and door thresholds,[86,3] slipping on wet floors,[87] and descending stairways.[5,88] In the hospital and nursing home, factors related to falling appear to be quite similar to those found in the home. The most common location for falls is the bedroom[69,81,89] with the majority occuring during bed transfers.[111,112] Bed rails in the up position do not seem

to protect against falling, but may actually increase falls, as patients try to climb over the rails when getting out of bed.[92,93] The bathroom is another common location,[115,116] most falls occurring during toilet transfers.[96,97] Chairs and wheelchairs contribute to falls as a result of poor patient transfer technique.[119,126] A causal relationship between falls and the use of assistive devices (i.e., canes, walkers) has been found by some,[121,1261] while others have found either no relationships[121] or a reduction in falls.[98,91] The use of physical restraints to prevent falls has, in some studies, actually contributed to further falls,[92,97] presumably due to improper application. The number of staff members present has been discussed as a factor relating to falls. Some have found that falls increase when staff levels are minimum,[99] and that falls decrease when staff levels are increased.[129] The peak incidence for institutional falls occurs during the first week of stay.[100,101]

While there is insufficient research available on environmental modification and fall reduction, assessment of environmental hazards and their correction will minimize fall risk (Table I).

When evaluating the home or institutional environment, many potential fall hazards can be identified, and some present more risk to an individual than others. To determine which environmental factors require correction, the environmental assessment should take place in conjunction with an observed functional assessment. Only by watching an older person maneuver and function in his living environment can a clear determination be made as to which aspects of the environmental setting are safe or hazardous. Observe the patient walking over different floor surfaces (linoleum, ceramic tile, carpets, etc.): climb and descend stairs (if present); transfer on and off chairs, beds, toilets; get in and out of the shower or bathtub, and reach up or bend down to obtain objects from closets and kitchen shelves. The functional assessment should be modified according to the environmental setting and the health status of the patient.

THE HISTORY AND PHYSICAL EVALUATION

To obtain as much information as possible about the fall, the history should include, in addition to a comprehensive review of all medical problems and medications, a precise accounting of the event (Table II). The physical examination of the patient should consist of a comprehensive medical, neurological, and functional status evaluation to identify intrinsic problems that may contribute to the fall. Specific emphasis should be placed on examining the cardiovascular, neurological, and musculoskeletal systems (Table III).

TABLE I. ENVIRONMENTAL MODIFICATION

Obstacle	Modification
Ground surfaces	
Highly polished or wet floors contribute to slipping.	In bathrooms recommend nonslip, glazed ceramic tile, non-slip adhesive strips placed on floor next to tub, sink and toilet, or indoor-outdoor carpet, which also reduces the risk of fall-related physical injury. Linoleum floors can be rendered slip-free with use of slip-resistant floor wax and minimal buffing. Keep a nonskid floor mat by kitchen sink to guard against wet floor.
Thick pile carpets may lead to tripping.	Avoid thick pile or shag carpets. Recommend carpets of uncut, low pile.
Area rugs and mats may lead to sliding falls.	Recommend that all rugs/mats have non-skid backing or line back with double-faced adhesive tape.
Patterned carpets may lead to spatial misjudgement in persons with decreased depth perception.	Recommend plain, unpatterned carpets.
Lighting	
Poor environmental lighting may hide tripping/slipping hazards.	Increase lighting in high-risk fall locations (i.e., stairs, bathroom, bedroom).
Distracting glare from sunlight or lights shining on polished floors and un-shielded light bulbs may impair vision.	Polarized window glass or application of tinted material to windows will eliminate glare without reducing light. Floor glare can be reduced by placing carpets on floor or repositioning light sources so that they do not shine directly on the floor.
Stairs	
Poor lighting may contribute to stairway tripping.	Place light switches at top and bottom of stairs to avoid traveling darkened stairways, or place night lights by first and last step to provide visual cueing of steps. Placement of colored nonslip adhesive strip will help define step edges.
Loss of balance on stairs may lead to serious falls.	Install handrails on both sides of stairs. Handrails should be round and set out far enough from the wall to allow for a good grasp.
Bathroom	
Sink edges and towel bars may be used as assistive devices	Replace towel bars with nonslip grab bars. Apply nonslip adhesive strips to top of sink to prevent slipping if grasped.
Transfer falls from low toilet seats.	Advise the use of elevated toilet seat and grab bars placed on wall next to toilet.
A slip and loss of balance may occur in the bathtub or	Place nonslip adhesive rubber strips or mat with suction cups on tub floor. Install nonslip grab bars in and around bath-

shower.	tub/shower. Advise use of shower chair and flexible hand held shower hose for balance of impaired persons.
Beds	
Transfer falls from high/low beds	A bed height of approximately 18 inches (from top of mattress to floor) will allow for safe transfers. Institutions can achieve a safe transfer height by using height adjustable beds.
Poor sitting balance may lead to bed falls.	Bed mattress edges should be firm enough to support a seated person without sagging.
Chairs	
Transfer falls from low-seated chairs.	A chair height of 14 to 16 inches (from seat edge to floor) and armrests to provide leverage during rising/sitting will allow for safe transfers.
Shelves	
Reaching or bending to retrieve objects from high or low shelves can lead to inbalance and falling.	Rearrange frequently used kitchen and closet items to avoid excessive reaching/bending. Shelf storage should be between a patient's hip and eye level. Encourage the use of hand held reacher devices to obtain objects.

TABLE II. THE FALL HISTORY

A previous history of falling
Time of fall (hour of day)
Location
Symptoms experienced
Activity engaged in
Device utilization
Presence of witness

SUMMARY

Most falls in older people can be prevented or reduced in frequency if clinicians first begin to view the fall as symptomatic of an underlying problem and, second, perform comprehensive assessments to uncover a multitude of medical, psychological, and environmental factors that may cause falling.

TABLE III. FALL ASSESSMENT

Evaluation	Rationale
Blood pressure in supine and sitting/ standing position	Evaluate presence of orthostatic hypotension.
Visual	Evaluate acuity, peripheral and horizontal fields of vision and color discrimination.
Cardiovascular:	
Pulse rate	Presence of arrhythmia
Neck turning extension	Presence of carotid or vertebro-basilar artery involvement
Carotid bulb massage	Presence of carotid sinus sensitivity
Gait/Balance/Musculoskeletal Function	
Rise from chair.	Observe for proximal muscle weakness.
Perform deep knee bend.	Observe for quadriceps weakness.
Walk ten feet in a straight line.	Observe posture, balance, presence of arm swing, stride length, and steppage height.
Climb/descend flight of stairs.	Observe balance movements of legs, and use of handrails.
Tandem walk	Observe for loss of balance.
Walk on toes/heels.	Observe for plantar/dorsiflexion at ankles and loss of balance.
Romberg test	Observe for increased sway/loss of balance.
Stand on tip toes and reach arm upward (as if reaching for an object from a high shelf).	Observe for loss of balance.
Bend down and pick up an object from the ground.	Observe for loss of position sense, sitting balance and proximal muscle strength.
Podiatric	Presence of foot abnormalities causing gait dysfunction (i.e., corns, bunions, hammer toes, etc.)

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